Development of a Regression Model to Identify Waterbodies Susceptible to Mercury Contamination in Fish Tissue in New England

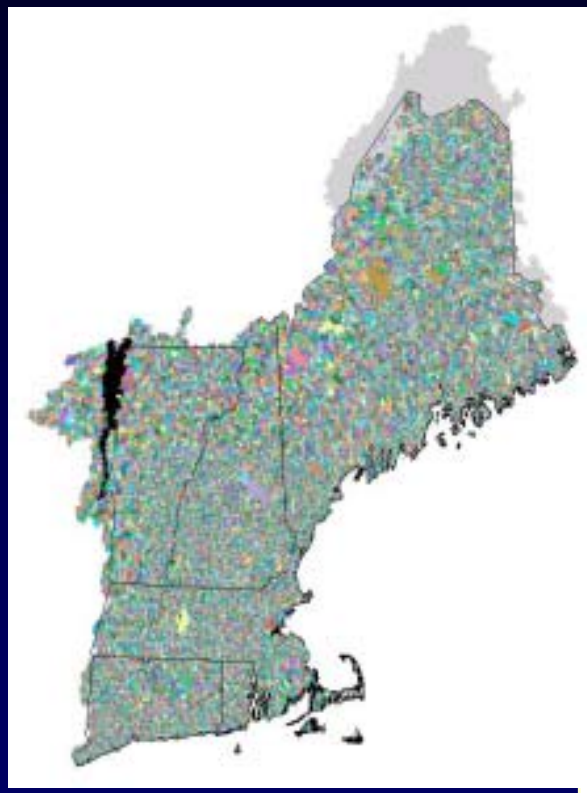
Fish Tissue, Water-Quality, and Watershed Data

USEPA
NESCAUM
NERC

NEIWPCC
USGS

History of Regional Model

Evolved out of nutrient SPARROW model



SPARROW Predicted Nitrogen Yield

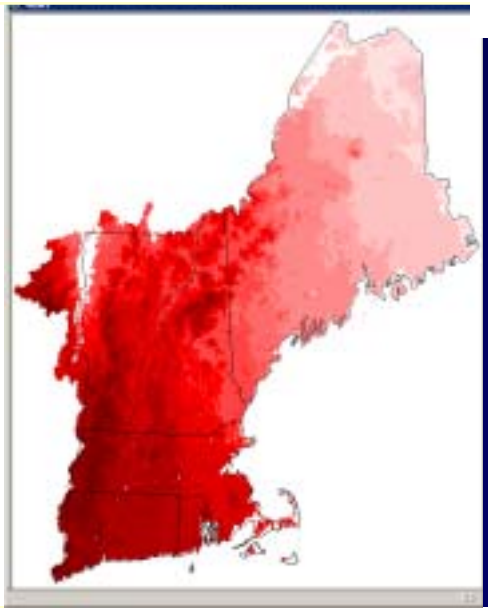
Catchment Yield (kg / sq km)

- 100
- 200
- 250
- 300
- 400
- 500
- 600
- 800
- 1,000
- 1,500
- 2,300
- 2,700 - 4,800
- 4,800 - 10,000
- 10,000 - 32,000
- > 32,000

SPARROW Predicted Nitrogen Yield Atmospheric Deposition

Catchment Yield (kg / sq km)

- 0 - 142
- 142 - 165
- 165 - 187
- 187 - 209
- 209 - 228
- 228 - 248
- 248 - 267
- 267 - 290
- 290 - 411
- 411 - 616



Merganser Model???

MERcury Geo-spatial AssessmeNtS
For the New England Region

Objectives

- Identify watershed and environmental factors affecting Hg levels in lake fish
- Estimate mean Hg concentrations and ranges in selected species
- Estimate relative magnitude of Hg sources contributing to Hg in fish tissue

Approach

- Compilation of data
- Statistical analysis
- Exploratory model
- New England Model
- Work collaboratively with others

Major Data Components

- Hg in Fish Tissue
- Lake Chemistry
- Watershed Features
- Atmospheric Deposition
- Hg Point Sources

USGS Focus

- Hg in Fish Tissue
- Lake Chemistry
- Watershed Features
- Model Development and Application

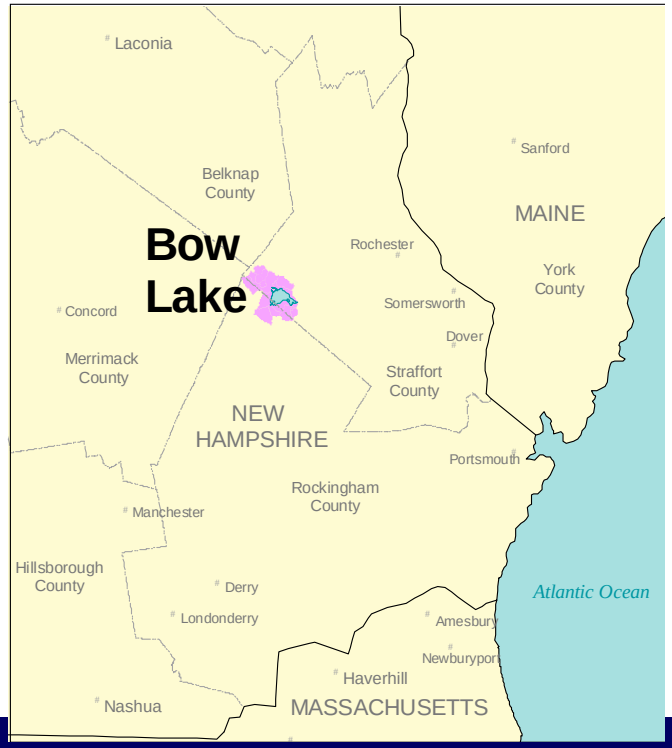
Building a New England Fish-Tissue Data Base

- Initial compilation of 3600 Hg fish tissue data points for 310 lakes/ponds
- Rely on NERC fish tissue data base to complete data base
- Determine species/genus to model

An Example - Bow Lake, NH

Fish tissue data available for white and yellow perch, largemouth and smallmouth bass, rainbow trout

(Source: R. Estabrook, NHDES)



Building Lake Water-Quality Data Bases

- Focus on important water-quality variables
- Initial compilation of 1200 water chemistry values for 360 lakes/ponds
- Rely on ENSR lake nutrient, NERC, state chemistry data bases
- Apply GIS and statistical modeling techniques to fill in gaps

Bow Lake, NH – Water Quality Data

Phosphorus and nitrogen concentration, conductivity,DO, pH, alkalinity, chlorophyll, color, secchi depth, trophic class

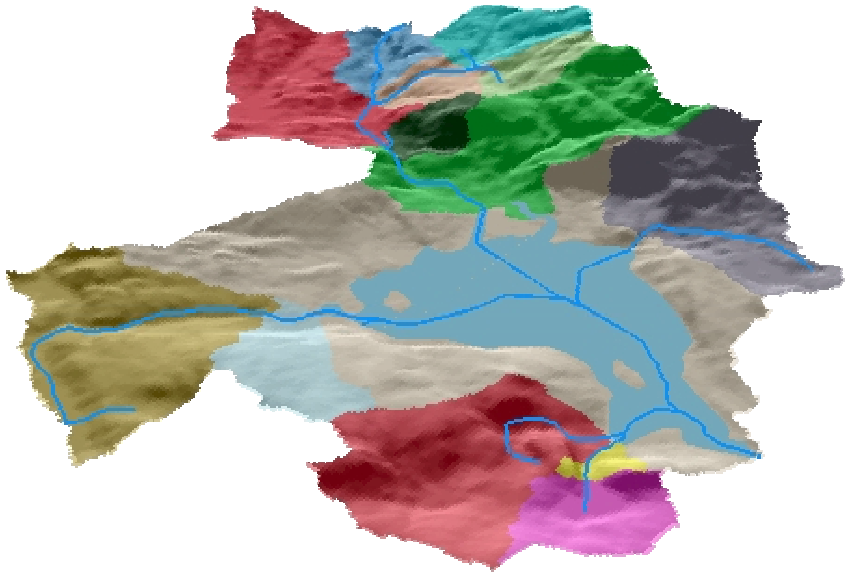
(Source: R. Estabrook, NHDES)

Building Lake Hydrography Data Base

- Use New England SPARROW model hydrography
- 9,000 of 14,000 lakes and ponds mapped in the NHD are defined as part of the SPARROW network
- Need to determine if all lakes and ponds are to be included in model

Bow Lake, NH – Hydrography

Lake, tributaries and their catchments delineated



Defining physical characteristics of lake watersheds

- Utilize existing SPARROW watershed attributes
- Identify other physical attributes that may be important and incorporate (e.g. lakes experiencing annual drawdown

Bow Lake, NH – Physical characteristics of watershed

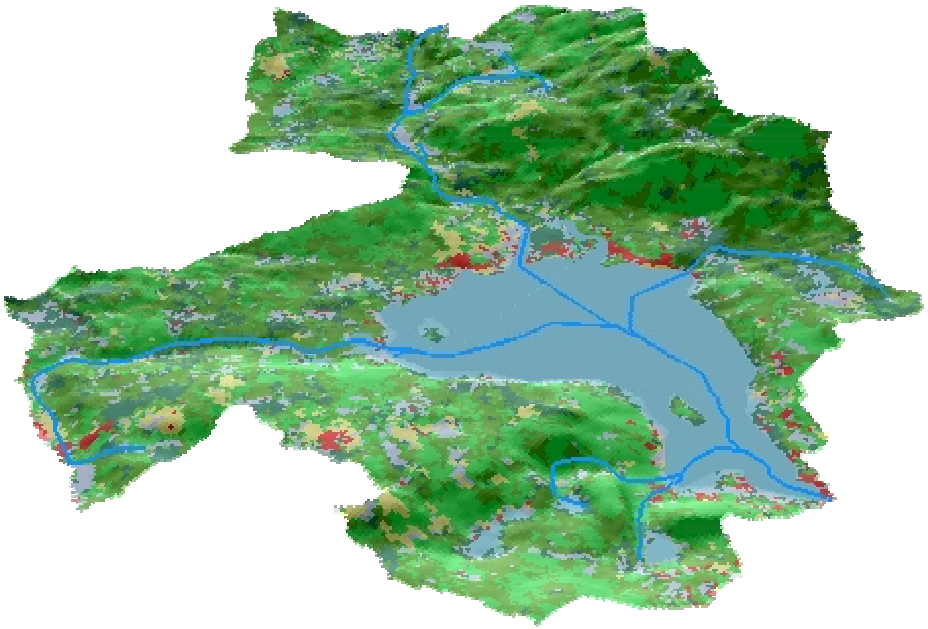
Drainage area size, estimated mean annual flows to lake, estimated residence time (surface area/outflow discharge), mean slope, stream density, soil permeability, annual average precip and temperature

Defining land use and other potential local sources

- Land use based on National Land Cover Data from 1992
- Permitted wastewater discharges for nutrients
- Incorporate local mercury emission sources
- Improved definition of wetlands is desirable (USF&WS Nat Wetlands Inventory)

Bow Lake, NH –Land Use

National Land Cover Data for 1992 defined into 6 general and 18 specific land use classes



Model Development

Exploratory Model

- **Develop/test for NH and VT?**
- **Determine most suitable data bases, important predictors, logical dependent variable**

Region-Wide Model Development and Application

- **Calibrate based on existing data and bootstrap analysis; apply model to lakes with no tissue data**
- **Error estimates will be available**
- **Predictions of mercury levels in tissue, probability of exceeding FDA consumption advisory level/EPA criterion**